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Test and Evaluation Report of the SSCOR PacVac Portable Suction Pump Model 10002

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The SSCOR PacVac Portable Suction Pump Model 10002 was tested for electromagnetic interference/compatibility in the UH-60A helicopter under the U.S. Army Program for Testing and Evaluation of Equipment for Aeromedical Operations. The tests were conducted using current military and industrial standards and procedures for electromagnetic interference/compatibility and human factors. Since in-flight testing of the PacVac portable suction unit could not be completed, its compatibility with the U.S. Army medical evacuation UH-60A Blackhawk could not be determined.

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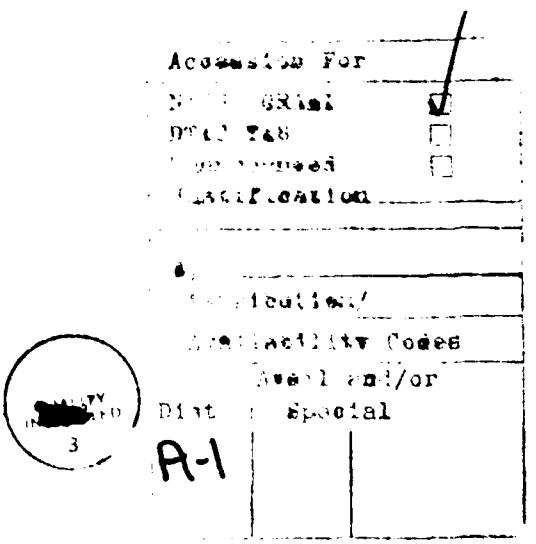

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Section 1. Executive digest

The Army program for Test and Evaluation of Aeromedical Equipment uses existing military standards (MIL-STD) and collective professional expertise to test and evaluate selected medical equipment proposed for use aboard Army aircraft. Equipment meeting these standards ensures the safety of the crew, patients, and aircraft by eliminating risks due to: (1) Interference by the medical equipment with aircraft systems/subsystems operation, (2) by the aircraft system's interference with the operation of the medical equipment, (3) the medical equipment's susceptibility to environmental exposure, or (4) physical and/or functional incompatibility while in use on board selected rotary-wing aircraft. This program tests both developmental and nondevelopmental (off the shelf) medical equipment destined for use aboard Army medical evacuation aircraft.

1.1 TEST OBJECTIVES

1.1.1 To determine if the medical equipment is complete and operational per the manufacturer's operating instructions.

1.1.2 To ensure the electrical safety of the medical equipment.

1.1.3 To ensure the equipment will function as designed throughout the rated battery operation time.

1.1.4 To ensure the safety of the operator, the patient, and the aircrew.

1.1.5 To assess design considerations which, potentially, could contribute to an operator error.

1.1.6 To determine if the medical equipment can function as designed in a low-pressure environment.

1.1.7 To determine the ability of the medical equipment to withstand the vibrational stresses expected in a rotary-wing flight environment without degradation or malfunction.

1.1.8 To determine the ability of the medical equipment to be stored and operated in a high-temperature environment.

1.1.9 To determine the ability of the medical equipment to be stored and operated in a low-temperature environment.

1.1.10 To determine the ability of the medical equipment to operate satisfactorily for short periods of time during exposure to highly humid conditions.

1.1.11 To assess the levels of electromagnetic emissions produced by the medical equipment within selected frequency ranges.

1.1.12 To assess the minimum electromagnetic susceptibility levels of the medical equipment within selected frequency ranges.

1.1.13 To assess the physical and/or functional compatibility of the medical equipment while in use on board the aircraft.

1.1.14 To assess the electromagnetic interference (EMI) and electromagnetic compatibility (EMC) characteristics of the medical equipment with the host aircraft and its installed systems.

1.2 TESTING AUTHORITY

Research and Technology Work Unit Summary, dated 5 October 1989. Project number 3M463807D836, titled, Army Program for Testing and Evaluation of Equipment for Aeromedical Operations.

1.3 SCOPE

1.3.1 This test was conducted at the United States Army Aeromedical Research Laboratory (USAARL), Cairns Army Airfield (CAAF), and designated test flight areas in and around Fort Rucker, Alabama.

1.3.2 The USAARL UH-60A aircraft, serial number 88-26069, with subsystems delineated in paragraph 3.2.2, was available for flight testing of the SSCOR PacVac portable suction pump*. The PacVac suction pump was not available for flight testing.

1.3.3 Laboratory testing was accomplished at USAARL using government furnished equipment (GFE) by Universal Energy Systems, Inc. (UES), under contract No. DAMD 17-86-C-6215.

1.3.4 Prior to flight testing the following tests were accomplished: Acceptance inspection, equipment training, electromagnetic compatibility, human factors and safety, environmental compatibility, and in-flight compatibility.

1.3.5 An airworthiness release (AWR) dated 16 August 1990 was received from the U.S. Army Aviation Systems Command (AVSCOM).

1.4 MATERIAL DESCRIPTION

The SSCOR PacVac portable suction pump is a battery-operated suction pump for pharyngeal suctioning during resuscitation emergencies. Batteries are recharged by an ac charger included with the unit. It is designed to be ready for immediate suctioning and to provide 30 minutes of suction in the event of a

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* See list of manufacturers

resuscitation emergency. Suction power is switchable between two power settings. The pump also is equipped with a disposable collection canister containing a hydrophobic filter element to prevent aerosolization of particles down to 0.45 micron diameter.

1.5 SUMMARY

1.5.1 Laboratory testing

1.5.1.1 Battery Life Evaluation: The battery in the PacVac portable suction unit provided power for an average of 45 minutes in three cycles of charging and operation. This is the maximum time specified in the operation manual for the suction unit.

1.5.1.2 Human Factors Evaluation: The PacVac suction unit was found satisfactory in all major categories of the evaluation. Standards referenced include MIL-STD-1472D, AAMI Human Factors Engineering Guidelines, and UL-544.

1.5.1.3 Environmental Tests: The PacVac portable suction can be expected to perform in a variety of environmental conditions. Its performance was found to be satisfactory in all stages of the environmental testing.

1.5.1.4 Radiated Emissions Tests (RE02): The PacVac portable suction unit may be unsatisfactory for use in certain EMI sensitive environments. Broadband emissions were detected in the test frequency ranges that exceeded the test limits. Emission limits are set forth in MIL-STD-461A, Notice 4.

1.5.1.5 Radiated Susceptibility Test (RS03): The PacVac portable suction unit was not found to be susceptible to radiated emissions.

1.5.2 In-flight testing

In-flight testing of the PacVac portable suction unit could not be accomplished. The manufacturer of the PacVac suction unit, Model 10002, discontinued production of this unit and none was available from the manufacturer or local military medical units for in-flight testing.

1.6 CONCLUSIONS

Since in-flight testing of the PacVac portable suction unit could not be completed, its compatibility with the U.S. Army medical evacuation UH-60A Blackhawk with the subsystems listed in paragraph 3.2.2 could not be determined.

Section 2. Subtests

2.1 INITIAL INSPECTION

2.1.1 Objective

To determine if the PacVac portable suction unit is complete and operational for testing per the manufacturer's operating instructions.

2.1.2 Criteria

2.1.2.1 The physical inventory was conducted solely for investigation and documentation.

2.1.2.2 The PacVac suction will suction 550 mL of water through a vacuum line in 7.5 seconds or less. This is equivalent to 550 mmHg suction or 25 liters per minute airflow.

2.1.3 Test procedure

2.1.3.1 A complete physical inventory of the PacVac suction unit was completed per the manufacturer's equipment list.

2.1.3.2 An operational validation test of the PacVac suction unit was conducted per the manufacturer's operating instructions by USAARL's medical maintenance personnel.

2.1.4 Test findings

2.1.4.1 The PacVac suction unit was inventoried and found to be complete.

2.1.4.2 The PacVac suction unit operated as prescribed in the manufacturer's operating manual, P/N not available. Criterion met.

2.2 BATTERY LIFE EVALUATION (Laboratory)

2.2.1 Objective

To ensure the equipment will function as designed throughout the rated battery operation time.

2.2.2 Criterion

Verify manufacturer's specified full power battery life expectancy of 30 to 45 minutes continuous operation.

2.2.3 Test procedure

2.2.3.1 Charging and operation cycles were conducted in ambient room conditions of 23°C, 40-60 percent relative humidity (RH).

2.2.3.2 The PacVac suction unit was operated continuously at full speed with no load until no suction was detected.

2.2.4 Test findings

The suction unit operated continuously for an average of 45 minutes before a low battery condition was noted. This performance is consistent with the manufacturer's specification of 30 to 45 minutes operation on a fully charged battery. Criterion met.

2.3 HUMAN FACTORS EVALUATION (Laboratory)

2.3.1 Objectives

2.3.1.1 To assure the safety of the operator, the potential patient, and the aircrew.

2.3.1.2 To assess the design considerations which could potentially contribute to an operator error.

2.3.2 Criterion

The PacVac portable suction unit must be rated satisfactory in all major categories of the evaluation. These include visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.

2.3.3 Test procedure

2.3.3.1 The evaluation was conducted in a laboratory under fluorescent lighting and ambient room conditions.

2.3.3.2 The PacVac suction unit was operated according to prescribed instructions through its full range of functions.

2.3.4 Test finding

The PacVac suction unit was found to be satisfactory in all major areas of the evaluation. Criterion met.

2.4 ALTITUDE (LOW PRESSURE) TEST [IAW METHOD 500.2, MIL-STD-810D]

2.4.1 Objective

To determine if the PacVac suction unit can function as designed in a low-pressure environment.

2.4.2 Criterion

The PacVac suction unit will function as designed while exposed to an altitude equivalency of 15,000 feet above sea level.

2.4.3 Test procedure

2.4.3.1 A pretest performance check was conducted to ensure proper operation of the PacVac suction unit.

2.4.3.2 The Altitude Test was performed in a Tenney Engineering model 64S altitude chamber*. This test is based on MIL-STD-810D, Method 500.2. The PacVac suction unit was placed in operation near the center of the floor of the chamber. The PacVac suction unit was turned on by means of a remote arm through the chamber wall and monitored for ability to suction 550 mL water in less than 7.5 seconds. Chamber pressure was decreased to 420 mmHg (15,000 ft equivalent altitude) over a 15-minute period, held constant for 60 minutes, then raised, at 1500 fpm, to ambient conditions (760 mmHg) over a 10-minute period. There are no provisions for the control of temperature or humidity inside this chamber.

2.4.3.3 A posttest performance check was conducted to ensure proper operation of the PacVac suction unit after the exposure to low pressure.

2.4.4 Test findings

2.4.4.1 The pretest performance check met criterion 2.1.2.2.

2.4.4.2 No failures in the PacVac suction unit's performance were noted before, during, or after the altitude test. Criterion met.

2.4.4.3 The posttest performance check met criterion 2.1.2.2.

2.5 VIBRATION TEST [IAW METHOD 514.3, MIL-STD-810D]

2.5.1 Objective

To determine the ability of the PacVac suction unit to withstand the vibrational stresses expected in a rotary-wing environment without degradation or malfunction.

2.5.2 Criterion

While exposed to vibrational stresses, the PacVac suction unit will remain operational.

2.5.3 Test procedure

2.5.3.1 A pretest performance check was conducted to ensure proper operation of the PacVac suction unit.

2.5.3.2 The vibration test was performed using an Unholtz-Dickey model TA115-40/CSTA vibration test system*. It is a single-axis system with an electromagnetic driver unit. The test consisted of sinusoidal vibrations, superimposed on random vibrations over a frequency range of 500 Hz, as shown below. These vibrations are derived from measurements taken on the floor under the co-pilot's seat in a UH-1 helicopter traveling at 120 knots. The reference spectrum breakpoints are from MIL-STD-810D, Method 514.3; reference spectrum levels are based on field measurements with a conservatism factor of 1.5. Independent tests were conducted in the X, Y, and Z axes.

Z-axis

duration: 60 minutes
broadband intensity: 0.4506 G_{rms}
random vibration: initial slope : 99.00 dB/Hz
5 Hz level: 0.00006210 $G_{sqr/Hz}$
100 Hz level: 0.0006210 $G_{sqr/Hz}$
300 Hz level: 0.0006210 $G_{sqr/Hz}$
500 Hz level: 0.00006210 $G_{sqr/Hz}$
final slope: -99.00 dB/oct
sinusoidal vibration: .5450 G_{pk} at 11.25 Hz
.1690 G_{pk} at 22.50 Hz
.1200 G_{pk} at 33.75 Hz
.0310 G_{pk} at 45.00 Hz
.0530 G_{pk} at 56.25 Hz

X and Y axes

duration: 60 minutes each
broadband intensity: 0.3099 G_{rms}
random vibration: initial slope: 99.00 dB/oct
5 Hz level: 0.00002920 $G_{sqr/Hz}$
100 Hz level: 0.0002920 $G_{sqr/Hz}$
300 Hz level: 0.0002920 $G_{sqr/Hz}$
500 Hz level: 0.00002920 $G_{sqr/Hz}$
final slope: -99.00 dB/oct
sinusoidal vibration: .3200 G_{pk} at 11.25 Hz
.0670 G_{pk} at 22.50 Hz
.0950 G_{pk} at 33.75 Hz
.0350 G_{pk} at 45.00 Hz
.0770 G_{pk} at 56.25 Hz

The PacVac suction unit was strapped to the vibration table fixture, and its performance was evaluated before, during, and after exposure to vibration.

2.5.3.3 A posttest performance check was conducted to ensure proper operation of the PacVac suction unit.

2.5.4 Test findings

2.5.4.1 The pretest performance check met criterion 2.1.2.2.

2.5.4.2 No failures in the PacVac suction unit's performance occurred before, during, or after exposure to vibration. Criterion met.

2.5.4.3 The posttest performance check met criterion 2.1.2.2.

2.6 HIGH TEMPERATURE TEST [IAW METHOD 501.2, MIL-STD-810D]

2.6.1 Objective

To determine the ability of the PacVac suction unit to be stored and operated in a high-temperature environment.

2.6.2 Criteria

2.6.2.1 During the high-temperature operation check, the PacVac suction unit must display consistent performance.

2.6.2.2 After the high-temperature storage cycle, the PacVac suction unit must be able to display consistent performance.

2.6.3 Test procedure

2.6.3.1 A pretest performance check was conducted to ensure proper operation of the PacVac suction unit.

2.6.3.2 The high-temperature test was conducted in a Tenney Engineering model ZWUL-10107D Walk-in Controlled Environment Chamber*. This test is based on MIL-STD-810D, Method 501.2. For the high-temperature operation test, the PacVac suction unit was placed in operation on a wire test stand near the center of the environmental chamber. The chamber temperature was raised to 49°C and the humidity was stabilized at a maximum of 20 percent RH within 15 minutes. The environmental control system is capable of regulating temperature within ± 2°C and humidity within ± 5 percent RH. Temperature and humidity were held constant for 2 hours. At 30-minute intervals, the chamber door was opened briefly to minimize the change in chamber conditions during performance checks. After the operational test, the PacVac suction unit was allowed to return to ambient conditions over a 30-minute period.

2.6.3.3 A posttest performance check was conducted to ensure proper operation of the PacVac suction unit.

2.6.3.4 The PacVac suction unit was stored (not operated) at temperatures of 63°C for 1 hour, 71°C for 4 hours, then again at 63°C for 1 hour. The chamber and PacVac suction unit then were returned to ambient conditions over a 30-minute period.

2.6.3.5 A poststorage performance check was conducted to ensure proper performance of the PacVac suction unit.

2.6.4 Test findings

2.6.4.1 The pretest performance check met criterion 2.1.2.2.

2.6.4.2 No operational failures occurred during the high-temperature test. Criterion met.

2.6.4.3 The posttest performance check met criterion 2.1.2.2.

2.6.4.4 The PacVac suction unit functioned properly after the high-temperature storage test. Criterion met.

2.7 LOW TEMPERATURE TEST [IAW METHOD 502.2, MIL-STD-810D]

2.7.1 Objective

To determine the ability of the PacVac suction unit to be stored and operated in a low-temperature environment.

2.7.2 Criteria

2.7.2.1 During the low-temperature operation check, the PacVac suction unit must display consistent operation.

2.7.2.2 After the low-temperature storage cycle, the PacVac suction unit must be able to display consistent operation.

2.7.3 Test procedure

2.7.3.1 A pretest performance check was conducted to ensure proper operation of the PacVac suction unit.

2.7.3.2 The PacVac suction unit was placed on the floor of the environmental chamber and the temperature was lowered to 0°C within 25 minutes. The environmental control system is capable of regulating temperature within 2°C. Humidity cannot be controlled in the chamber at freezing temperatures. The temperature was held constant for 2 hours. At 30-minute intervals, the chamber door was opened briefly to minimize the change in chamber conditions, and a performance check was conducted. The chamber temperature then was raised to ambient temperature within a 30-minute period.

2.7.3.3 A posttest performance check was conducted to ensure proper operation of the PacVac suction unit.

2.7.3.4 The PacVac suction unit was "stored" in a nonoperational mode with the power cord coiled and placed on top of the PacVac suction unit. The PacVac suction unit was placed on the floor of the environmental test chamber and the temperature was lowered to -46°C for 6 hours. The chamber then was raised to ambient temperature over a 30-minute period.

2.7.3.5 A poststorage performance check was conducted to ensure proper operation of the PacVac suction unit.

2.7.4 Test findings

2.7.4.1 The pretest performance check met criterion 2.1.2.2.

2.7.4.2 No operational failures occurred during the low-temperature test. Criterion met.

2.7.4.3 The posttest performance check met criterion 2.1.2.2.

2.7.4.4 The PacVac suction unit functioned properly after the low-temperature storage test. Criterion met.

2.8 HUMIDITY TEST [IAW METHOD 507.2, MIL-STD-810D]

2.8.1 Objective

To determine the ability of the PacVac suction unit to operate satisfactorily for short periods of time during exposure to highly humid conditions.

2.8.2 Criterion

While exposed to a high humidity environment, the PacVac suction unit must display consistent operation.

2.8.3 Test procedure

2.8.3.1 A pretest performance check was conducted to ensure the proper operation of the PacVac suction unit.

2.8.3.2 The humidity test was conducted in a Tenney Engineering model ZWUL-10107D Walk-in Controlled Environment Chamber*. This test is based on MIL-STD-810D, Method 507.2. For the humidity test, the PacVac suction unit was placed in operation on a wire test stand near the center of the environmental chamber. The chamber temperature was raised to a temperature of 29.5°C and a relative humidity of 95 percent within 25 minutes. Temperature and relative humidity were maintained for 4 hours. The environmental control system is capable of regulating temperature within ± 2°C and humidity within ± 5 percent RH. At 45-minute intervals, the suction performance was checked. The chamber door was opened briefly to minimize the change in chamber conditions. The chamber and the PacVac suction unit were returned to ambient conditions before the posttest performance validation check was conducted.

2.8.3.3 A posttest performance check was conducted to ensure the proper operation of the PacVac suction unit.

2.8.4 Test findings

2.8.4.1 The pretest performance check met criterion 2.1.2.2.

2.8.4.2 No operational failures occurred during the humidity test. Criterion met.

2.8.4.3 The posttest performance check met criterion 2.1.2.2.

2.9 ELECTROMAGNETIC CHARACTERISTICS TEST [IAW MIL-STD-461A, Notice 4, and MIL-STD-462, Notice 3]

2.9.1 Objectives

2.9.1.1 To assess the maximum levels of radiated electromagnetic emissions produced by the PacVac suction unit in the 14 kHz to 1.0 GHz frequency range.

2.9.1.2 To assess the tolerances of radiated electromagnetic susceptibility of the PacVac suction unit within the 10 kHz to 10 GHz broadband electric field and the 14 kHz to 12.4 GHz narrowband.

2.9.2 Criteria

2.9.2.1 The PacVac suction unit shall not produce emissions in excess of the limits set forth in paragraph 6.13, MIL-STD-461A, Notice 4.

2.9.2.2 The PacVac suction unit shall not malfunction when it is subjected to radiated emissions as specified in paragraph 6.20, MIL-STD-461A, Notice 4.

2.9.3 Test procedure

2.9.3.1 The radiated emissions test was performed according to MIL-STD-462, Notice 3, Method RE02. The PacVac suction unit was positioned on a wooden test stand 1 meter tall, 0.18 meters wide, and 0.21 meters long, inside the EMI chamber. The unit was directly in line with, and at a horizontal distance of 1 meter from the receiving antennas. The antennas were mounted for both vertical and horizontal polarities and connected to the appropriate EMI receivers. Electrometrics EMC-25 and EMC-50 receivers were used for this test. Their frequency ranges in testing are 14 kHz to 1 GHz and 1 to 12.4 GHz. Broadband and narrowband detection methods were used from 14 kHz to 1 GHz. Narrowband detection methods were used from 1 to 12.4 GHz. The suction unit operated continuously when tested.

2.9.3.2 The radiated susceptibility test was performed according to MIL-STD-462, Notice 3, Method RS03. The PacVac suction unit was positioned on a wooden test stand 1 meter tall, 0.18 meters wide, and 0.21 meters long, inside the EMI chamber. The unit was directly in line with, and at a horizontal distance of 1 meter from the transmitting antennas. The antennas were mounted for both vertical and horizontal polarities and connected to radio frequency (RF) transmitters. The suction unit was exposed to fields of 10 V/m from 200 MHz to 2 GHz, and 5 V/m from 2 to 10 GHz. All RF carrier waves were 50 percent amplitude modulated with a 1000 Hz tone.

2.9.4 Test findings

2.9.4.1 During the radiated emissions test, broadband emissions from 14 kHz to 718 MHz were detected which exceeded specification limits of MIL-STD-461A, Notice 4, by 0.2 to 24.8 dB. Criterion partially met.

2.9.4.2 The PacVac suction unit was not susceptible to radiated emissions. Criterion met.

2.10 IN-FLIGHT HUMAN FACTORS EVALUATION

2.10.1 Objective

To assess the physical and/or functional compatibility of the PacVac suction unit while in use on board the aircraft.

2.10.2 Criterion

The flight surgeon shall be able to operate the PacVac suction unit without physical or functional restrictions aboard the aircraft. Major areas of concern include: Proper operation, visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.

2.10.3 Test procedure

Not applicable since unit not available for in-flight testing.

2.10.4 Test findings

Not available since suction unit not available for in-flight testing. Criterion not evaluated.

2.11 IN-FLIGHT EMI/EMC CHARACTERISTICS TEST

2.11.1 Objective

To assess the EMI/EMC characteristics of the PacVac suction unit with the host aircraft and its installed systems.

2.11.2 Criteria

2.11.2.1 The PacVac suction unit shall not radiate EMI to disrupt or interfere with other equipment or systems aboard the aircraft.

2.11.2.2 The aircraft shall not radiate EMI to disrupt or interfere with the PacVac suction unit's operation.

2.11.3 Test procedure

A qualitative EMI/EMC assessment will be performed with both the PacVac suction unit and the aircraft operating as source and victim. The PacVac suction unit and applicable aircraft instruments and systems will be monitored for unusual operation, readings, surges, or power anomalies.

2.11.4 Test findings

Not available since suction unit not available for in-flight testing. Criterion not evaluated.

Section 3. Supporting documentation

3.1 DETAILED TEST INFORMATION

3.1.1 General information

3.1.1.1 PacVac suction unit testing is not considered a major action significantly affecting the quality of the human environment and, therefore, qualifies for categorical exclusion A-28, AR 200-1, Appendix A.

3.1.1.2 A safety pilot will be designated for each flight. Flight operations will be conducted IAW the aircraft operator's manual, appropriate aircrew training manuals, and test item technical data.

3.1.2 Material description

3.1.2.1 The PacVac portable suction unit is a rechargeable, battery-operated pump for pharyngeal suctioning during resuscitation emergencies. The pump operates on 12 volts dc, supplied by an rechargeable internal sealed lead acid battery. The battery can be recharged in 4 to 6 hours using the 120 Vac recharger supplied with the unit. It is designed to be available for immediate operation and to operate on battery power for 30 to 45 minutes. Suction power is switchable between two power settings. This provides 550 mmHg suction with full power or 80 mmHg with the regulator valve open. Secretions are collected in a collection canister. Standard accessories include an 800 mL collection canister, vacuum connecting line, battery charger, and cordura carrying case.

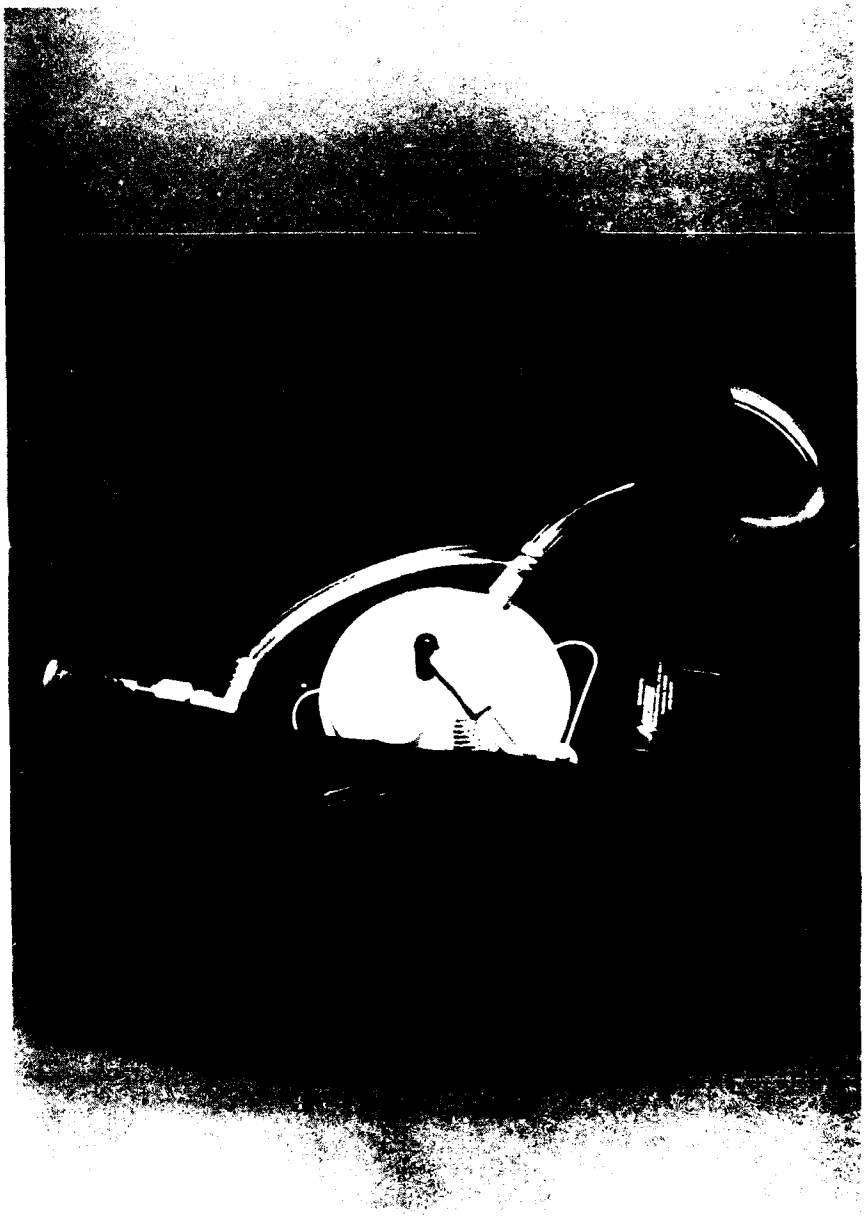
3.1.2.2 Dimensions: 10 x 8 x 15 inches (25.4 x 20.3 x 38.1 cm).

3.1.2.3 Weight: 11 lbs (5 kg).

3.1.2.4 Power requirements: 12 volts dc supplied by internal sealed lead-acid battery. Battery recharged by 120 Vac recharger. The unit will operate the pump for 30 to 45 minutes on a fully charged battery and requires 4 to 6 hours to recharge the battery.

3.2 TEST DATA

3.2.1 Photographic description



3.2.2 Aircraft equipment list

Item No.	Nomenclature
1	Receiver radio -- R-1496A/ARN-89 (automatic direction finder)
2	Displacement gyro -- CN-1314/A
3	Gyro directional -- CN-998/ASN-43
4	Signal data converter -- CV-3338/ASN-128
5	Receiver -- R-2139/ARN-123 (VOR/LOC/MB/GS)
6	Command instrument system processor -- 70600-01038-101
7	SAS amplifier -- 70901-02908-104 (flight control stability augmentation system)
8	Rate gyro -- TRU-2A/A
9	Amplifier, impedance -- AM-4859A/ARN-89
10	Cargo hook -- FE-7590-145
11	Receiver, radar -- RT-1193/ASN-128 (doppler navigation receiver)
12	Barometric altimeter -- AAU-31/A-1
13	Barometric altimeter -- AAU-32A
14	Receiver/transmitter -- RT-1300/ARC-186 (VHF-AM and/or FM radio)
15	UHF-AM radio set -- RT-1518/ARC-164
16	Interphone control -- C6533/ARC (aircraft intercom control)
17	Receiver/transmitter -- RT-1115D/APN-209 (radar altimeter)
18	Indicator altimeter -- ID-1917C/APN-209 (radar altimeter)
19	Control radio set -- C-7392A/ARN-89 (automatic direction finder)
20	Comparator signal data -- CM-482/ARC-186 (comparator for ARC-186)
21	Receiver/transmitter -- RT-1296A/APX-100 (transponder with IFF)
22	Computer display unit -- CP-1252/ASN-128 (doppler navigation system)
23	Compass set controller -- C-8021E/ASN75
24	Magnetic compass - standby -- MS-17983-4

3.2.3 Battery life evaluation

Battery Life Evaluation
Report Form

Nomenclature: PacVac portable suction
Manufacturer: SSCOR
Model number: 10002
Serial number: 105
Military item number: None

Options installed: None

Manufacturer battery life specification: 30 to 45 minutes continuous operation.

Specified battery recharge time: 4 to 6 hours to fully charge a depleted battery.

Specified mode of operation under battery power: Suction with no load.

Overall performance: Pass

Measurements: The unit averaged 45 minutes continuous operation.

Comments: None

3.2.4 Human factors evaluation

Human Factors Evaluation
Report Form

Nomenclature: PacVac portable suction
Manufacturer: SSCOR
Model number: 10002
Serial number: 105
Military item number: None

Options installed: None

Date of test: 7 Sep 88

Item configuration during test: Item prepared for operation, sitting on a counter top.

Checklist for HFE

RESULTS

VISUAL DISPLAYS: n/a

display type, format, content
location of displays
indicator lights
scalar displays
color coding
legends and labels
cathode ray tubes
counters
flags, go-no-go, center-null indicators

Comments: None

CONTROLS: Satisfactory

location
characteristics of controls
labeling
control - display relationships

Comments: None

TIME REQUIRED TO PREPARE FOR OPERATION (list in comment)

Comments: Less than 2 minutes.

MAINTAINABILITY: **Satisfactory**

component location
component characteristics
rests and stands
covers, cases, access doors
handles
lubrication
component mounting
cord storage provisions
external accessibility
internal accessibility
list special tools required
list realistic inspection requirements
list realistic inspection intervals

Comments: None

CONDUCTORS: **Satisfactory**

binding and securing
length
protection
routing
conductor coding
fabrication
connectors

Comments: None

FASTENERS: **Satisfactory**

access through inspection panel covers
enclosure fasteners
device mounting bolts and fasteners

Comments: None

TEST POINTS: **n/a**

general
location and mounting
test point labeling and coding

Comments: None

TEST EQUIPMENT: Satisfactory

general
equipment self-test
indicators (list in comments)
controls
positive indication of proper operation

Comments: None

FUSES AND CIRCUIT BREAKERS: Satisfactory

external accessibility
easy replacement or reset by operator

Comments: None

LABELS AND CODING: Satisfactory

placed above controls and displays
near or on the items they identify
not obscured by other equipment components
describe the function of the items they identify
readable from normal operating distance
conspicuous placards adjacent to hazardous items

Comments: None

SAFETY: Satisfactory

manual
materials
fire and explosive protection
operator protection from mechanical hazards
patient protection from mechanical hazards
electrical safety (operator and patient)

Comments: None

3.2.5 Altitude test

Altitude Test
Report Form

Nomenclature: PacVac portable suction
Manufacturer: SSCOR
Model number: 10002
Serial number: 105
Military item number: None

Options installed: None

Date of test: 26 Aug 88

Item configuration during test: Item turned on in the standby mode, operating on dc (battery) power, sitting on chamber floor.

Performance test criteria: Pump suctions 550 mL water in less than 7.5 seconds.

Ambient conditions outside chamber:

Temperature	100°F
Humidity	50% RH
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	None (battery)
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	Battery charger

IN-TEST DATA

Time of test start: 1420

POSTTEST DATA

Posttest performance check (complete check of item and accessories):

Time of test end: 1545

Item functional (based on performance test criteria): Yes

Deviation from pretest : None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

3.2.6 Vibration test

Vibration Test
Report Form

Nomenclature: PacVac portable suction
Manufacturer: SSCOR
Model number: 10002
Serial number: 105
Military item number: None

Options installed: None

Date of test: 26 Aug 88

Item configuration during test: Item strapped down on vibration table fixture; ac and dc operation.

Performance test criteria: Pump suctions 550 mL water in less than 7.5 seconds.

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	None (battery)
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	Battery charger

IN-TEST DATA

Data and performance checks during test:

Times of test start: 0827

Time at first check:
X: 0835 Y: 0950 Z: 1245

Item functional (based on performance test criteria): Yes

Deviation from pretest: None

Time at second check:
X: 0925 Y: 1045 Z: 1330

Item functional (based on performance test criteria): Yes

Deviation from pretest: None

POSTTEST DATA

Posttest performance check (complete check of item and accessories):

Item functional (based on performance test criteria): Yes

Item intact: Yes

Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): High frequency vibrations, probably resulting from loose batteries inside the unit, caused momentary shutdown of vibration table circuits.

Comments on other data: None

3.2.7 High temperature test

High Temperature Test
(Equipment Operating)
Report Form

Nomenclature: PacVac portable suction
Manufacturer: SSCOR
Model number: 10002
Serial number: 105
Military item number: None

Options installed: None

Date of test: 1 Sep 88

Item configuration during test: Unit was sitting on chamber floor, ready for operation.

Performance test criteria: Consistent and accurate displays and measurements.

Ambient conditions outside chamber:

Temperature	23°C
Humidity	55% RH
Barometric Pressure	1 atm

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	None
list connections to simulators	None
list connections to dummy loads	Reservoir of water
list unconnected terminals	None
distance from north wall (meters)	0.75
distance from south wall (meters)	0.75
distance from east wall (meters)	2.0
distance from west wall (meters)	2.0
distance from ceiling (meters)	2.16
distance from floor (meters)	0.0

IN-TEST DATA

Time of test start: 0900

Performance checks during test:

First check:

Time:	1000
Temperature:	48.8°C
Humidity:	16% RH
Barometric pressure:	1 atm
Item functional (based on performance test criteria)	Yes, all OK
Deviation from pretest:	None

Second check:

Time:	1030
Temperature:	49°C
Humidity:	16% RH
Barometric pressure:	1 atm
Item functional (based on performance test criteria)	Yes, all OK
Deviation from pretest:	None

Third check:

Time:	1100
Temperature:	49°C
Humidity:	15% RH
Barometric pressure:	1 atm
Item functional (based on performance test criteria)	Yes, all OK
Deviation from pretest:	None

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end:	1130
Item functional (based on performance test criteria)	Yes, all OK
Deviation from pretest:	None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

3.2.8 High temperature storage test

High Temperature Test
(Equipment in Storage)
Report Form

Nomenclature: PacVac portable suction
Manufacturer: SSCOR
Model number: 10002
Serial number: 105
Military item number: None

Options installed: None

Date of test: 2 Sep 88

Item configuration during test: Sitting on chamber floor, in storage, not operating.

Performance test criteria: Suctions 550 mL water in less than 7.5 seconds.

Ambient conditions outside chamber:

Temperature	25°C
Humidity	91% RH
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	None
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	Battery charger
distance from north wall (meters)	0.75
distance from south wall (meters)	0.75
distance from east wall (meters)	2.0
distance from west wall (meters)	2.0
distance from ceiling (meters)	2.6
distance from floor (meters)	0.0

Time of test start: 0800

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end: 1500
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

3.2.9 Low temperature test

Low Temperature Test
(Equipment Operating)
Report Form

Nomenclature: PacVac portable suction
Manufacturer: SSCOR
Model number: 10002
Serial number: 105
Military item number: None

Options installed: None

Date of test: 1 Sep 88

Item configuration during test: Sitting on chamber floor, ready for operation.

Performance test criteria: Suctions 550 mL water in less than 7.5 seconds.

Ambient conditions outside chamber:

Temperature	23°C
Humidity	50% RH
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	None
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	None
distance from north wall (meters)	0.75
distance from south wall (meters)	0.75
distance from east wall (meters)	2.0
distance from west wall (meters)	2.0
distance from ceiling (meters)	2.0
distance from floor (meters)	0.0

Time of test start: 1310

Performance checks during test:

First check:

Time:	1340
Temperature:	0°C
Humidity:	n/a
Barometric pressure:	1 atm
Item functional (based on performance test criteria):	Yes
Deviation from pretest:	None

Second check:

Time:	1415
Temperature:	0°C
Humidity:	n/a
Barometric pressure:	1 atm
Item functional (based on performance test criteria):	Yes
Deviation from pretest:	None

Third check:

Time:	1445
Temperature:	0°C
Humidity:	n/a
Barometric pressure:	1 atm
Item functional (based on performance test criteria):	Yes
Deviation from pretest:	None

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end:	1515
Item functional (based on performance test criteria):	Yes
Deviation from pretest:	None

Comments on item setup or checks: None

Comments on test run (including interruptions):
Condensation on unit was allowed to dry before final performance check.

Comments on other data: None

3.2.10 Low temperature storage test

Low Temperature Test
(Equipment in Storage)
Report Form

Nomenclature: PacVac portable suction
Manufacturer: SSCOR
Model number: 10002
Serial number: 105
Military item number: None

Options installed: None

Date of test: 6 Sep 88

Item configuration during test: Sitting on chamber floor, in storage, not operating.

Performance test criteria: Pumps 550 mL water in less than 7.5 seconds.

Ambient conditions outside chamber:

Temperature	25°C
Humidity	50% RH
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	None
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	Battery charger
distance from north wall (meters)	0.75
distance from south wall (meters)	0.75
distance from east wall (meters)	2.0
distance from west wall (meters)	2.0
distance from ceiling (meters)	2.6
distance from floor (meters)	0.0

Time of test start: 0745

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end: 1445
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: The unit was allowed to return to ambient conditions overnight before final performance check.

3.2.11 Humidity test

Humidity Test
Report Form

Nomenclature: PacVac portable suction
Manufacturer: SSCOR
Model number: 10002
Serial number: 105
Military item number: None

Options installed: None

Date of test: 7 Sep 88

Item configuration during test: The unit was sitting on the chamber floor, ready for operation.

Performance test criteria: Pumps 550 mL water in less than 7.5 seconds.

Ambient conditions outside chamber:

Temperature	23°C
Humidity	87% RH
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power	None
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	Battery charger
distance from north wall (meters)	0.75
distance from south wall (meters)	0.75
distance from east wall (meters)	2.0
distance from west wall (meters)	2.0
distance from ceiling (meters)	2.6
distance from floor (meters)	0.0

IN-TEST DATA

Time of test start: 0800

Performance checks during test:

First check:

Time:	0915
Temperature:	29.5°C
Humidity:	95% RH
Barometric pressure:	1 atm

Item functional (based on performance test criteria): All OK
Deviation from pretest: None

Second check:

Time:	1000
Temperature:	29.5°C
Humidity:	95% RH
Barometric pressure:	1 atm

Item functional (based on performance test criteria): All OK
Deviation from pretest: None

Third check:

Time:	1045
Temperature:	29.5°C
Humidity:	95% RH
Barometric pressure:	1 atm

Item functional (based on performance test criteria): All OK
Deviation from pretest: None

Fourth check:

Time:	1130
Temperature:	29.5°C
Humidity:	94% RH
Barometric pressure:	1 atm

Item functional (based on performance test criteria): All OK
Deviation from pretest: None

Fifth check:

Time:	1215
Temperature:	29.5°C
Humidity:	94% RH
Barometric pressure:	1 atm

Item functional (based on performance test criteria): All OK
Deviation from pretest: None

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)
Time of test end: 1430
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

3.2.12 Electromagnetic characteristics test

****

Electromagnetic Characteristics Testing
Evaluation of Performance
****

T & E Item Number: 07 Date: 1 Sep 88

Nomenclature: PacVac portable suction
Manufacturer: SSCOR
Model number: 10002
Serial number: 105
Military item number: n/a

****

Conducted Emissions Tests

CE01 Testing configuration(s): n/a
Performance (pass/fail): n/a

Comments: None

CE02 Testing configuration(s): n/a
Performance (pass/fail): n/a

Comments: None

CE04 Testing configuration(s): n/a
Performance (pass/fail): n/a

Comments: None

Conducted Susceptibility Tests

CS02 Testing configuration(s): n/a
Performance (pass/fail): n/a

Comments: None

CS06 Testing configuration(s): n/a
Performance (pass/fail): n/a

Comments: None

Radiated Emissions Tests

RE02 Testing configuration(s): Operating on wooden test stand in the EMC chamber
Performance (pass/fail): Fail

Comments: BB failures 0.2 to 24.8 dB over specification, 14 kHz to 718.2 MHz.

Radiated Susceptibility Tests

RS03 Testing configuration(s): Operating on the wooden test stand in the EMC chamber.

Performance (pass/fail): Pass

Comments: Item connected to a pressure meter to allow continuous assessment of pump suction.

3.3 CRITERIA, SIGNIFICANT PROBLEMS, AND SUGGESTED IMPROVEMENTS

3.3.1 Criteria

Item No.	Criteria (Source)	Remarks	Applicable subparagraph
1	The physical inventory is conducted solely for investigation and documentation.	n/a	2.1.2.1
2	The PacVac suction unit will display consistent and accurate measurements.	met	2.1.2.2
3	Verify manufacturer's specified full power internal battery life expectancy of 30 to 45 minutes.	met	2.2.2
4	The PacVac suction unit will be rated satisfactory in all major categories of the evaluation. These include: Visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.	partially met	2.4.2
5	The PacVac suction unit will display consistent and accurate measurements while exposed to an altitude equivalency of 15,000 feet above sea level.	met	2.5.2
6	The PacVac suction unit will remain operational and display consistent and accurate measurements while exposed to vibrational stresses.	met	2.6.2
7	The PacVac suction unit will display consistent and accurate measurements during the high temperature operation check.	met	2.7.2.1
8	The PacVac suction unit will display consistent and accurate measurements after the high temperature storage.	met	2.7.2.2

9	The PacVac suction unit will display consistent and accurate measurements during the low temperature operation check.	met	2.8.2.1
10	The PacVac suction unit will display consistent and accurate measurements after the low temperature storage.	met	2.8.2.2
11	The PacVac suction unit will display consistent and accurate measurements while exposed to a high humidity.	met	2.9.2
12	The PacVac suction unit will not produce emissions in excess of the limits set forth in MIL-STD-461A, Notice 4, paragraph 6.13.	partially met	2.10.2.1
13	The PacVac suction unit will not malfunction when it is subjected to radiated fields as specified in MIL-STD-461A, Notice 4, paragraph 6.20.	met	2.10.2.2
14	The flight surgeon will be able to operate the PacVac suction unit without physical or functional restrictions aboard the aircraft.	not tested	2.11.2.1
15	The PacVac suction unit will not radiate EMI to disrupt or interfere with the other equipment or systems aboard the aircraft.	not tested	2.12.2.2
16	The aircraft will not radiate EMI to disrupt or interfere with the PacVac suction unit.	not tested	2.12.2.3

3.3.2 Significant problems which require corrective action

None

3.3.3 Suggested improvements

None

3.4 REFERENCES

3.4.1 Department of Defense. 1971. EMI characteristics, requirements for equipment. Washington, D.C. MIL-STD-461A, Notice 4. February.

3.4.2 Department of Defense. 1971. EMI characteristics, measurement of. Washington, D.C. MIL-STD-462, Notice 3. February.

3.4.3 Department of Defense. 1983. Environmental test methods and engineering guidelines. Washington, D.C. MIL-STD-810D. July.

3.4.4 Department of the Army. 1982. Environmental protection and enhancement. Washington, D.C. Army Regulation 200-1. June.

3.4.5 Department of the Army. 1987. Maintenance management procedures for medical equipment. Washington, D.C. TB 38-750-2. April.

3.4.6 Department of Defense. 1985. Standard general requirements for electronic equipment. Washington, D.C. MIL-STD-454K. February.

3.4.7 Underwriters Laboratory's, Inc. 1978. Standard for safety, medical and dental equipment. Chicago, Illinois. UL-544.

3.4.8 Department of Defense. 1989. Human engineering design criteria for military systems, equipment, and facilities. Washington, D.C. MIL-STD-1472D. March.

3.4.9 Association for the Advancement of Medical Instruments. 1988. Human factors engineering guidelines and preferred practices for the design of medical devices. Arlington, Virginia. AAMI-HE-1988. February.

3.4.10 Department of the Army. 1978. Operator's manual, UH-60 and EH-60 helicopter, with changes 1-5. Washington, D.C. TM 55-1520-237-10. January.

3.4.11 Mitchell, G. W., and Adams, J. E. 1988. Technical test and evaluation of aeromedical equipment. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL Letter Report LR-88-16-1-2.

3.5 ABBREVIATIONS

ac	alternating current
AEST	aeromedical equipment suitability test
atm	atmosphere
AVSCOM	U.S. Army Aviation Systems Command
AWR	airworthiness release
BB	broadband
BPM	beats per minute
CAAF	Cairns Army Airfield
CRT	cathode ray tube
dB	decibel
dc	direct current
EMC	electromagnetic compatibility
EMI	electromagnetic interference
fpm	feet per minute
GFE	government furnished equipment
GHz	gigahertz
Gpk	gravity, peak
G(rms)	gravity (root mean square)
Hz	hertz
IAW	in accordance with
IGE	in-ground effect
ITOP	in-flight test operating procedure
kHz	kilohertz
KIAS	knots indicated airspeed
LCD	liquid crystal display
LED	light emitting diode
MEDEVAC	medical evacuation
MHz	megahertz
MIL-STD	military standard
mL	milliliter
mm	millimeter
mmHg	millimeters of Mercury
m.s.l.	mean sea level
NB	narrowband
NBC	nuclear, biological and chemical
NiCad	nickel cadmium
NVG	night vision goggle

PacVac	SSCOR PacVac portable suction pump
RAM	random access memory
RF	radio frequency
RH	relative humidity
ROM	read only memory
TB	technical bulletin
TFT	technical feasibility testing
T & E	test and evaluation
UES	Universal Energy Systems, Inc.
USAARL	U.S. Army Aeromedical Research Laboratory
V/m	volts per meter

3.6 LIST OF MANUFACTURERS

3.6.1 SSCOR
1210 El Vago Street
La Canada, CA 91011

3.6.2 Sikorsky Aircraft
6900 Main Street
Stratford, CT 06601

3.6.3 Tenney Engineering, Inc.
1090 Springfield Road
Post Office Box 3142
Union, NJ 07083

3.6.4 Unholtz-Dickey Corporation
6 Brookside Drive
Wallingford, CT 06492

3.7 DISTRIBUTION LIST

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National Naval Medical Center
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Natick, MA 01760

U.S. Army Avionics Research and Development Activity
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Fort Monmouth, NJ 07703-5401

U.S. Army Communications-Electronics Command
ATTN: AMSEL-RD-ESA-D
Fort Monmouth, NJ 07703

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Naval Submarine Medical Research Lab
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Naval Air Development Center
Warminster, PA 18974

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Naval Air Development Center
ATTN: Code 602-B (Mr. Brindle)
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Research Laboratory
ATTN: DRXBR-OD-ST Tech Reports
Aberdeen Proving Ground, MD 21005

Commander
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Institute of Chemical Defense
ATTN: SGRD-UV-AO
Aberdeen Proving Ground,
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ATTN: SGRD-RMS (Ms. Madigan)
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Falls Church, VA 22041-3258

Naval Research Laboratory
Library Code 1433
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U.S. Army Materiel Systems
Analysis Agency
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MD 21005-5071

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U.S. Army Environmental
Hygiene Agency
Building E2100
Aberdeen Proving Ground, MD 21010

Technical Library Chemical Research
and Development Center
Aberdeen Proving Ground, MD
21010--5423

Commander
U.S. Army Medical Research
Institute of Infectious Disease
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Fort Detrick, Frederick, MD 21702

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Commandant
U.S. Army Aviation
Logistics School ATTN: ATSQ-TDN
Fort Eustis, VA 23604

Headquarters (ATMD)
U.S. Army Training
and Doctrine Command
Fort Monroe, VA 23651

Structures Laboratory Library
USARTL-AVSCOM
NASA Langley Research Center
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Hampton, VA 23665

Naval Aerospace Medical
Institute Library
Building 1953, Code 03L
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Command Surgeon
HQ USCENTCOM (CCSG)
U.S. Central Command
MacDill Air Force Base FL 33608

Air University Library
(AUL/LSE)
Maxwell Air Fore Base, AL 36112

U.S. Air Force Institute
of Technology (AFIT/LDEE)
Building 640, Area B
Wright-Patterson
Air Force Base, OH 45433

Henry L. Taylor
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